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AUTHOR Lynch, Mervin D.
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ABSTRACT

The Mini Rat (Remote Associates Test) was developed in response to the need for creativity measures with which one could study the consequences of elementary school teaching on the students' creative potential. It is an associative measure with 20 items in which children are asked to give verbal responses to word doublets in the form of third words which are more or less equally associated with each of the two words in the doublet. Thus, the test employs logic similar to that used in the original RAT which was developed for high school and college level students. Words for the Mini Rat items were selected from word lists and books suitable for grades 1-3. Two studies of the validity of the measure for children in grades 1 and 3 are described. The measure discriminated in expected ways between a priori categorized groups of high and low creative children. The hypothesis that it takes a creative person to recognize a creative child was not supported. Grade and sex differences were evident on one test form but not on another. Split-half reliability coefficients were .78 for Form A and .79 for Form B. (CK)

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THE MINI RAT: ITS DEVELOPMENT AND SOME EVIDENCE ON ITS VALIDITY

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By

Mervin D. Lynch

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A major criticism of present day education has been that creativity is stifled by the educational practices prevalent in elementary schools (Silberman, 1970; Holt, 1967; and Kozal, 1967). Given this possibility and the centrality of the problem to current educational practices there would seem to be a pressing need to develop and validate creativity measures with which to study the consequences of elementary school teaching, especially those for the children with creative potential.

The present paper reports on the development of alternate forms of one such measure labeled the Mini Rat and provides experimental evidence from two studies on the validity of this measure for children in grades 1 and 3. The Mini Rat is an associative measure in which children are asked to give verbal responses to word doublets in the form of third words which are more or less equally associated with each of the two words in the doublet.

Background

Prior research on creativity has focused mainly on the development and application of creativity tests for individuals in adult populations (e.g., Dearborn, 1898; Simpson, 1922; Andrews, 1930; Guilford, 1956 and Mednick, 1962). In some of these tests, individuals were asked to interpret ink blots or drawings and in others, personal observations

of individuals were made by judges. The verbal response output from these tests has not been readily amenable to scaling scoring or analysis, and this has raised serious problems in terms of bias, objectivity and reliability. Hence, these measures have little utility in extension to elementary grade children.

Guilford and associates (1956) as part of their more general research on the structure of the intellect, operationalized creativity in terms of a multi-dimensional construct. With the aid of factor analysis they identified six aptitude traits which "belong most clearly in the area of creativity" and provided measurement procedures for indexing individual traits on each construct. The constructs were: fluency of thinking, flexibility of thinking, originality, sensitivity to problems, redefinition and elaboration. Measures of some but not all of these traits were developed and validated for individuals at fifth grade level or above, but these measures were not extended to lower grade levels in this research.

Torrance (1962), chose four of the traits identified by Guilford and associates and constructed a creativity test inventory with measures on each trait. The four traits were fluency, flexibility, originality and elaboration. In this inventory individuals were given tasks of asking questions, guessing causes, guessing consequences, telling imaginative stories, sounds and image problems, and incomplete and closed figures problems. The output of these tasks were in the form of figure and verbal completions and were difficult to scale and score. Torrance has provided extensive instructions on how to score his inventory, but the scoring is subjective and the criteria used in scoring are variable. Feldman (1971), has shown that almost any child

may be labeled as high in creativity depending upon the criterion the tester chooses for evaluation. Archambault (1970) has developed a computer program for scoring which apparently controls for problems of subjectivity and variability in scoring but begs the presently unanswered question about which of the possible criteria are being used to index creativity in his computer approach.

A major assumption of the work conducted by Torrance (1962) and Guilford and associates (1956) was that creativity is a multi-dimensional trait. Torrance collected considerable data on his creativity measures but did not subject it to factorial validation. Paulus (1970) gathered data on the Torrance measure and subjected these data to correlation and factor analysis. From this analysis he found only one rather than four identifiable factors. This finding raises some doubt about the validity of the Torrance creativity measures and may also indicate that creativity is a uni-dimensional not multi-dimensional construct.

Mednick and associates (1962) operationalized creativity in terms of an association theory construct and developed a measurement procedure labeled the Remote Associates Test (RAT). They define creative thinking as the "forming of associative elements into new combinations which meet specific requirements." In the RAT, an individual may form associative elements into new combinations by providing mediating connective links. He is asked to give written responses toward word triplets in the form of a fourth word which is associated more or less remotely with each of the three words in the triplet. The RAT has 30 items and the creativity score is comprised of the sum score of the correct responses to all 30 items.

The 30 items selected for use in the RAT were those with novel and restricted solutions and the restriction on response choice has raised some doubts about the validity of the RAT as a measure of creativity. Guilford has argued that creativity corresponds to divergent thinking where an individual when faced with a problem will reach many as opposed to one solution. Wallach and Kogan (1965) have suggested that the RAT measures convergent rather than divergent thinking insofaras each RAT item permits one or two rather than many correct response choices. Hence, the RAT may not be measuring creativity but its obverse e.g., usualness, unoriginality and so on.

Creative persons such as writers, artists, sculptors or musicians, in general will complete a creative act with one rather than many preferred solutions--i.e., one painting, one sculpture, and one musical or written composition. There may be many solutions produced on the way to the completion of a creative act, but the creative person generally selects the one that is preferred and rejects the remainder. Along similar lines, when working with the construct of creativity, it may be more appropriate to consider divergent thinking in terms of the number of paths to a solution rather than the number of solutions.

The RAT measurement seemingly depends more on the divergency or elaboration in the rule structure a person uses in reaching solutions to problems than on the number of solutions he reaches. In the RAT test a person is faced with making a correct novel response choice from among a diversity of possible associations. All else being equal, the more elaborate a person's rule structure for processing associations, the greater will be his probability of selecting a correct association and the more restricted will be his response choice. Hence, restricted

rather than unrestricted response choices should accompany creative thinking. This formulation is not entirely inconsistent with that by Guilford -- who seems to cover all bases of thinking with verbal alacrity -- since Guilford defines divergent thinking as inclusive of both the number of paths to a problem solution and the number of solutions to the problem.

There has been extensive developmental research on the RAT and in this research Mednick and associates have shown that the RAT was a valid and reliable measurement procedure. They have developed separate test forms for high school and college level individual, but the logic and method of measurement has not yet been extended to an elementary population. A major purpose in the present research was to develop a measure which would apply a similar logic as that of the RAT to measurement of creativity in elementary grade level children.

In two separate experimental studies words were selected at the vocabulary level of children in grades 1-3, and paired in various combinations to form word doublets. A screening was made to reduce the number of doublet items and an analysis was made on the degree of discrimination and difficulty of each doublet. A final selection of items was made in each of the studies, and these doublets constitute alternate forms of a creativity measure labeled the "Mini Rat." In each study, an experimental validation was carried out to see if the Mini Rat discriminated in expected ways and to see if the degree of discrimination differed according to grade levels, sex and classification by judges.

Method and Procedure

Word doublets rather than word triplets as were used in the RAT were selected for use in the Mini Rat. The word triplets seemed too

difficult a task for 5-8 year old children to complete. It seemed more realistic to expect a child of the 5-8 year age range to complete word association problems of word doublets.

The words for these doublets were selected from word lists and books available to children in grades 1-3. For example doublet items included tub and bubble, pine and ice cream and water and Autumn. These were paired to provide novel associative combinations and a diversity of semantic and syntactic associative rule structures; a procedure in keeping with the notion that the intensity of creative potential may be dependent on the degree of elaboration and degrees of freedom available in a person's rule structures.

An initial selection of 500 doublets was made for each of the two test forms and these were rated by graduate student judges in the College of Education at Northeastern University. Each doublet was rated on a 5 point scale in terms of novelity and quality of the associations between the third word and each pair of the doublets. By means of these ratings, the number of word doublets was reduced from 500 to 76 in study 1 and 80 in study 2.

In each study the doublets were divided into two test forms (38 items in study 1 and 40 in study 2) by randomized selection and responses were obtained to the doublets on each test from 24 children in grades 1-3. Graduate student judges administered the doublet items to two children each. Prior to the administration, the judges talked with each child for five minutes and then in study 1 the children were classified pair-wise as higher or lower in creativity and in study 2 each child was rated on a 15 point scale and classified as higher or lower in creativity on this basis. These ratings provided levels of high and low creativity of children.

In both studies the doublet items were administered verabally and responses were recorded by the administrators. The children practiced on three examples, and then the items were administered to each child three times. The first two administrations were made on the word doublets only and in the third administration the doublets were presented with clues. It was believed that the doublets may have been too difficult for first grade children, and hence, some clues may have been necessary at that level. Further, by means of this clue it was possible to see if a word doublet was unknown, or available in the response reportoire but was not one some children will come up with on their own. Discrimination, coefficients and difficulty scores were computed for the ratings on all items and these were used to select the doublet items for the Mini Rat.

In each of the two studies, 20 doublet items were selected for each form of the Mini Rat. Those selected were moderate in difficulty and high on level of discrimination. The range in difficulty for both test forms was from 15-70 and the range in discrimination from 10-60. These items represented at least 6 separate rule structures involving syntactic and semantic distinctions. Some examples are as follows.

Rule Structure	Word Doublets		Response
Both right associative	pine	ice cream	cone
Both left associative	ahoy	shape	ship
Right and left associative	peanut	fly	butter
Left and right associative	cob	pop	corn
Right associative and propositional assertion	wish	dog	bone
Right associative and a definitional assertion	water	Autumn	fall

Validity Test

Evidence on the validity of the Mini Rat comes from two experimental studies where purposes were threefold. The major purpose was to see if the measure discriminated in expected ways between a priori categorized groups of high and low creative children. Evidence that the Mini Rat discriminated as expected will support the validity of the measure.

A second purpose was to see if it takes a creative person to recognize a creative child. Evidence from prior research (Lynch, 1969) has shown that it takes a creative person to recognize creativity in writing and it may take a creative person to recognize creativity in another person. Individual differences in judge classification abilities may also effect the classification, discrimination and hence, the evidence on the validity of the measure.

A final purpose was to see if the Mini Rat discriminates as well for boys as girls and as well for first as third graders. Evidence to this effect will support the general applicability of the Mini Rat for testing at different grade levels and for testing individuals of different sexes.

Responses were obtained from a sampling of children, 88 on form A and 96 on form B. In each study, the children were selected such that half were in grade 1 and the other half in grade 3 providing two grade levels. Graduate student judges administered one form of the Mini Rat to four children each.

Judges (22 on form A and 24 on form B) were classified as high or low creative on the basis of test scores on the college level version of the RAT obtained on an a priori basis. The range of the RAT scores

in both studies was from 17-24 for the high creative and 8-16 for the low creative judges, and these ranges are consistent with those used in classifying persons in prior research with the RAT.

Each child was classified by a judge as high or low in creativity, on the basis of verbal story completions on each of two topics and these classifications were made prior to the administration of the Mini Rat. The story completion items were as follows:

1. Suppose you swallowed a potion that made you invisible. Where would you go? What would you do?

2. It is Halloween night, a child was walking home in the dark. He put a key into the lock. He opened the door. It was dark inside. He heard a bang. What was the bang?

All tests were administered verbally on an individual basis. Each child was shown 6 non-discriminating sample items. Once he seemed to understand the task, the Mini Rat was administered. Each form was administered twice to each child with 10 seconds response time for each item.

The conditions in both studies provided a 2 X 2 X 2 testing design with two levels of creativity for judges and children and two grade levels. Sex frequency allocations were permitted to vary. On form A, judges tested whichever sex child was available for testing, and this procedure resulted in an unequal number of boys and girls. On form B, each judge tested one child of each sex, yielding an equal number of boys and girls, but, classification as high or low creative resulted in unequal sex frequencies for interaction effects.

The dependent variable measure was the sum score of all correct responses on the 20 items on each form of the Mini Rat. In each of

the studies an analysis of variance was made on the Mini Rat scores. The mean Mini Rat scores for forms A and B are shown in Tables 1 and 2. The analyses of variance for forms A and B are presented in Tables 3 and 4.

--Tables 1 through 4 about here--

The results of the analyses in these two studies provide substantial support for the validity of the Mini Rat as a measure of creativity. Appreciable differences were found between high and low levels of creativity in children in both studies, and the scores for the high creative children were higher than those for the low creative children.

There were no differences between creativity levels for judges on either test form and this finding does not support the notion that it takes a creative person to recognize another creative person. Apparently persons of differing creative aptitude have some consistent standard for recognizing creativity in persons, a standard which may not carry over to the judgment of creativity in a product, but this needs to be studied.

The findings for the two studies were not consistent for the main effects on grade level and sex. On form A there was no difference between the Mini Rat scores for first and third graders while with form B third graders scored appreciably better than first graders. This difference may be attributed to the level of experience of the test administrators or to differences in level of associative processing at first and third grade levels. In form A , the judges were mainly elementary school teachers taking graduate level work, whereas in form B, none of the judges had elementary classroom experience, and the latter group may not have explained the task properly to the first grade

children. It may also be that third graders score better on this test, and to use this test for comparison purposes across grade levels, it may be necessary to control for chronological age, as is done in computing intelligence quotients.

There was an appreciable difference between sex on Mini Rat responses on form A but not form B, and on form A the girls scored appreciably higher than boys. This sex difference may be attributed to the disproportinate inclusions of different sexes in the sample on form A. Eight more boys than girls were tested on form A, while equal numbers of each sex were tested on form B. There was an appreciable sex by creativity interaction on form B which was the only significant interaction on either form. This interaction may be attributed to the relatively poor performance on the Mini Rat of boys in the low creativity condition. In addition, perhaps this interaction has concealed a main effect difference between sex and the girls in this sample either were more creative than boys, or the test was biased in favor of girls. A final possibility is that a majority of the administrators in both instances were girls (12 out of 22 on form A and 18 out of 24 on form B) and this may have produced a sex response bias.

Reliability. In the process of gathering data on the validity of the two forms of the Mini Rat, split half reliability coefficients were obtained. These were $r = .78$ for form A and $r = .79$ for form B. These reliability coefficients were high and consistent considering that they were obtained on different sets of doublets and for different samplings of children.

Sixth Grade Sample. The Mini Rat seems to be an appreciably reliable and valid measure of creativity for children in grades 1 and 3, and it may be applicable to children in higher grades. We have

obtained scores on form A from 270 sixth grade children, where the tests was administered in writing and measures on the CATB intelligence tests were available. The split half reliability on the Mini Rat was r = .87 and the correlations between the Mini Rat and some CATB intelligence test scores were: creativity - language IQ r = .20; creativity - non-language IQ r = .33 and creativity - IQ r = .27, a correlation which is similar to the r = .35 $\pm$ .20 generally found between adult scores on tests of creativity and intelligence.

The Mini Rat is a verbal measure using word doublets, and some may argue that it is only indexing a verbal level of functioning. The slightly higher correlation found in the sixth grade sample between non-language IQ and creativity and language IQ seems to indicate that the Mini Rat will assess non-verbal as well if not better than verbal levels of intellectual functioning.

The persons who administered the test were the same as those who judged the creativity level of children. The observed differences on both forms, while quite large, may be attributable to administrative bias. We are currently planning a study where the administrators and judges who classify will be different persons; for instance, a study where teachers will classify their students and graduate student help will administer the Mini Rat.

In selecting and refining doublet items for both forms, we offered children clues on the third time through the word doublets. When clues were introduced, the children used in doublet selection gave correct responses on all but one of the test items in form A and 2 test items in form B. Apparently the children had the correct choices in their response reportoire but some were unable to select the requisite choice

in response to the word doublets. What was at issue was not so much the availability of correct responses or the correct requisite association, so much as the ability to select that choice...and this seems to depend upon the degree of elaboration in the available rule structures for processing the doublet stimuli. The inability to select the requisite associations may be attributed to freezing, a possibility raised by Wallach and Kogan (1965). However, the Mini Rat was presented to children as a game and according to the administrators, the children were eager to complete the test, and wanted to continue with more items.

Table 1

MEAN MINI RAT SCORES FOR FORM A

Creativity of Judges by Creativity of Children by Grade

Children	Judges: High Creative	Low Creative	Marginal
High Creative Grades 1	11.91	11.18	11.55
3	12.45	12.73	12.59
Marginal	12.18	11.95	12.07
Low Creative Grades 1	6.73	7.91	7.32
3	7.45	8.73	8.09
Marginal	7.09	8.32	7.70
Grades 1	9.32	9.55	9.43
3	9.95	10.73	10.34
Marginal	9.63	10.14	9.89

Sex by Creativity of Children

Sex	Children: High Creative	Low Creative	Marginal
Male	11.08	7.25	9.17
Female	13.25	8.25	10.75
Marginal	12.07	7.70	9.89

Sex by Grade

Sex	Grade: 1	3	Marginal
Male	8.84	9.52	9.17
Female	10.21	11.24	10.75
Marginal	9.43	10.34	9.89

Table 2

MEAN MINI RAT SCORES FOR FORM B

Creativity of Judges by Creativity of Children by Grade

Children	Judges: High Creative	Low Creative	Marginal
High Creative Grades 1	8.83	8.25	8.54
3	12.33	12.42	12.38
Marginal	10.58	10.33	10.46
Low Creative Grades 1	7.75	7.17	7.46
3	9.00	11.08	10.04
Marginal	8.38	9.13	8.13
Grades 1	8.29	7.71	8.00
3	10.67	11.75	11.21
Marginal	9.48	9.73	9.60

Sex by Creativity of Children

Sex	Children: High Creative	Low Creative	Marginal
Male	10.28	8.35	9.35
Female	10.65	9.12	9.85
Marginal	10.42	8.75	9.60

Sex by Grade

Sex	Grade: 1	3	Marginal
Male	7.75	10.96	9.35
Female	8.25	11.46	9.85
Marginal	8.00	11.21	9.60

Table 3

ANALYSIS OF VARIANCE ON THE MINI RAT SCORES FOR FORM A

Source of Variance	Degrees of Freedom	Corrected Sums of Squares	Mean Square	F-Ratio
Between creativity of judges	1	5.50	5.50	-
Creativity of judge X grade (I)	1	1.64	1.64	-
Creativity of judge X creativity of children (I)	1	11.64	11.64	1.06
Creativity of judge X creativity of children X grade (I)	1	1.13	1.13	-
Individuals/creativity of judge X grade	20	251.18	12.56	
Individual/creativity of judge X creativity of children	20	219.45	10.97	
Individual/creativity of judge	20	672.37	33.62	
Between grades	1	18.18	18.18	2.44
Between sex	1	54.70	54.70	7.35•
Between creativity of children	1	418.91	418.91	44.47•••
Sex X creativity of children (I)	1	7.33	7.33	-
Sex X grade (I)	1	-	-	-
Grade X creativity of children (I)	1	.41	.41	-
Residual error	17	126.43	7.44	
Total	87	1,788.87		

• $p<.05$

••• $p<.001$

Table 4

ANALYSIS OF VARIANCE ON THE MINI RAT SCORES FOR FORM B

Source of Variance	Degrees of Freedom	Corrected Sums of Squares	Mean Square	F-Ratio
Between creativity of judges	1	1.50	1.50	-
Creativity of judge X grade (I)	1	16.67	16.67	3.57
Creativity of judge X creativity of children (I)	1	6.00	6.00	-
Creativity of judge X creativity of children X grade (I)	1	15.38	15.38	-
Individuals/creativity of judge X grade	22	98.29	4.67	
Individuals/creativity of judge X creativity of children	22	155.96	7.09	
Individual/creativity of judge	22	679.46	30.88	
Between grades	1	247.04	247.04	56.40•••
Between sex	1	6.00	6.00	1.37
Between creativity of children	1	70.04	70.04	15.99•••
Sex X creativity of children (I)	1	24.00	24.00	5.48•
Sex X grade (I)	1	-	-	-
Grade X creativity of children (I)	1	9.38	9.38	2.14
Residual error	19	83.24	4.38	
Total	95	1,412.96		

• $p<.05$

••• $p<.001$

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